SCOPE

Bioenergy & Sustainability: bridging the gaps

FAPESP
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ENVIRONMENTAL SECURITY: RESTORING SOILS AND PROTECTING ECOSYSTEMS WITH BIOENERGY CROPS

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Expansion of bioenergy crops

- **Pressure on soil, water and natural system resources**
  - **Land availability is not a constraint**
- **Can we sustainably produce enough feedstock?**

Expansion of bioenergy crops

Need to overcome risks of over-exploitation of natural resources

- **Erosion**
  - **Loss of good soil, sediment to water bodies, water pollution**
- **Nutrient depletion**
- **Loss of soil organic matter = loss of soil quality**
- **Water overuse and pollution**
- **Loss of natural ecosystems and biodiversity**

EROSION

Loss of soil, water, and nutrients: important in tropical and subtropical areas

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Bioenergy done right

High biomass yield (good agronomic practices)
Soil conservation
Soil protection (plant residues)

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Crop production done right: No-till / Conservation tillage widely adopted

High temperatures, intense rainfall and need to control erosion have turned No-till into a common practice: 30

Maintaining plant residues on the soil surface is a fundamental part of no-till in tropical soils of Latin America

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Sugarcane: high biomass yield. Trash preservation helps increase soil organic C

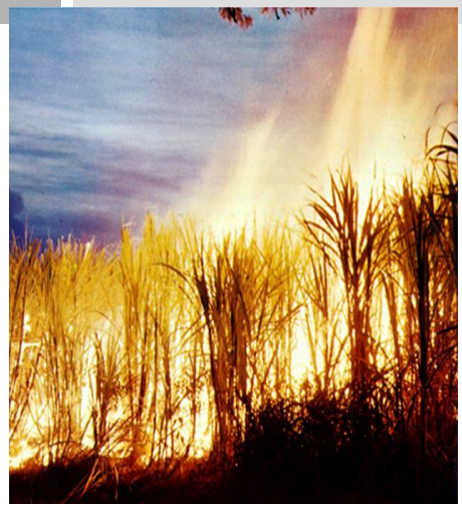
Trash preservation = high rate of C accumulation:
up to 1.5 Mg ha^{-1} yr^{-1}
(Lower values in other studies)

Soil type and climate and local conditions affect accumulation

Number of sites	Time span (years)	Carbon Stock 0-30 cm (Mg ha^{-1})		Annual soil C variation (Mg ha^{-1} yr^{-1})	
		Unburned	Burned	Range	Average
Sandy (5)	4 to 16	29 to 59	33 to 57	-0.14 to 1.45	0.73
Clayey (7)	3 to 12	44 to 70	57 to 83	1.59 to 2.38	2.04
					1.50 ±0.82

Data of 12 sites in Brazil, from several authors (Galdos et al. 2010)

Traditional Burn and Cut replaced: environmental gains



Good governance and appropriate legislation helped the transition from burned to green

Air pollution
Nutrient losses (N, S)
Biomass loss
Soil is unprotected

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Environmental, social, and economic impacts

Better working conditions and higher productivity: proper protection equipment; machines with air-conditioned cabins. Training and better salaries

Straw: bioenergy vs soil preservation

- Plant residues are disputed for 2G and thermal energy
- Need to harmonize energy production and long term soil quality
  - Highly site-specific
  - Research, information & regulation needed

Sensitive areas: proper choice and allocation of feedstock

- **Sandy soils**
- **Hilly terrain**
- **Water-scarce regions**
  - **Appropriate Governance and Legislation**
    - **Local and region water issues, ecosystem services, natural vegetation, and biodiversity**
  - **Perennial crops or forest plants are option**
    - **Example: Eucalyptus: 40 m^3 ha^{-1} yr^{-1} (6 Mha in Brazil)**

Forest plants are good options

Grow well in poor soils
Good and long-term soil cover
Combined with natural vegetation

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Recycling nutrients: bionergy residues back to the field

Vinasse

- **Ethanol 1G & 2G**
  - **High organic load and polluting potential**
  - **Environment risk if dumped in water bodies or excessive rates applied to soil**
- **Appropriate legislation & regulation, research and education:**
  - **Today vinasse is an asset rather than a problem in modern sugarcane systems**

Vinasse distribution/application

Vinasse is initially stored in tanks for distribution in the fields

Impermeable channels or pipelines are used in flat areas.
Pumping stations help distribute vinasse to far away fields

Concluding remarks

- **Agriculture done right allow us to produce enough biomass for bioenergy & preserve soil, water and the environment**
- **Good governance, legislation, and education are important to harmonize bioenergy, food, land preservation, natural ecosystems and biodiversity.**

Thank you

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